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Impact of tobacco price and taxation on affordability and consumption of tobacco products in the South-East Asia Region: A systematic review

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ABSTRACT

INTRODUCTION The objective of the review was to study the impact of tobacco taxes or prices on affordability and/or consumption of tobacco products in WHO South-East Asia Region (SEAR) countries, overall and by socioeconomic status; and change in consumption of one tobacco product for a given change in price/tax on another tobacco product.

METHODS The searches were made in five databases (Medline, Embase, Cinahl, EconLit, Tobacconomics) using keywords such as ‘tobacco’, ‘tax’, ‘price’, ‘impact’ with their synonyms. Additionally, the first 100 articles through google search and e-reports from targeted sources were also reviewed. Studies illustrating the impact of prices/taxes on consumption/affordability of tobacco products in SEAR, in English and with no limitation on year, were included in the review. After two steps of screening, data from 28 studies were extracted using a structured and pre-tested data extraction form.

RESULTS Of the 28 studies, 12 studies reported an inverse association between price and consumption/affordability, while 11 studies reported no or positive association between price and consumption/affordability of tobacco products. Five studies had unclear interpretations. The majority of studies estimated that the less affluent group were more price responsive compared to the more affluent group. Some studies indicated increased consumption of one product in response to price rise of another product, although, the findings were inconsistent.

CONCLUSIONS The findings of our review support the use of tobacco tax and price measures as effective tools to address the tobacco epidemic. Our findings, however, also emphasize the importance of increasing tobacco product taxes and prices sufficiently to outweigh the effects of income growth, in order for the measures to be effective in reducing the affordability and consumption of tobacco products.

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INTRODUCTION

Tobacco taxes influence the price, affordability and demand of tobacco products^{1,2}. Raising taxes on tobacco

products is one of the most cost-effective measures for reducing the consumption of tobacco³⁻⁵. However, to be effective in reducing tobacco consumption, the

tax increases need to result in increases in tobacco product prices that are sufficient to outweigh the effect of real income growth⁶. The change in affordability of tobacco products is an important determinant of the prevalence of use, especially in countries with rapid economic growth^{1,2}. In addition, change in affordability of a specific tobacco product can affect the consumption of other tobacco products⁶. Hence, while the price elasticity of demand estimates are often used to represent the relative price response for the demand of tobacco products *ceteris paribus*⁷, affordability (i.e. the percentage of income required to buy specific units of a tobacco product) has been proposed as an alternative for evaluating the impact of tobacco-control fiscal policies⁸. The affordability of tobacco products adjusts for the consumer's purchasing power and is dependent on the income of consumers and price of tobacco products. A higher affordability index relative to a reference point indicates that tobacco products have become more expensive (i.e. less affordable) in relation to the income of consumers. As a result of the decrease in affordability, their consumption, in turn, is expected to decrease^{9,10}.

The price response of the consumption of tobacco products can be even more complicated in the World Health Organization defined South-East Asia Region (WHO-SEAR, hereafter referred to as SEAR), which has a myriad of challenges related to tobacco fiscal policies. SEAR countries like India, Bangladesh, and Indonesia, comprise the top-twenty global tobacco producers¹¹. The wide variety of tobacco products, including smokeless tobacco and indigenous products, pose a significant challenge to levying and administering optimal levels of taxes on these products¹². In addition, there are also wide socioeconomic disparities within this region in terms of tobacco use and income/earnings^{10,13-16}. Only one (Thailand) out of the 11 SEAR countries has achieved the World Health Organization (WHO) best-practice recommendation, that of a minimum 75% of the retail price of a pack of cigarettes¹⁷. However, in some SEAR countries, the percentage of the retail price of a pack of cigarettes that is excise tax is very low, for example 19% in Timor-Leste¹⁷.

In 2003, Guindon et al.¹⁸ provided a summary of nine studies that reported data on the impact of tobacco price or per capita income on tobacco consumption across six SEAR countries. They reported an overall reduction in tobacco consumption in response to

its price increase and estimated price elasticities of -0.50 in the short-term and -0.70 in the long-term for tobacco products in this region¹⁸. The study also projected an increase in tobacco consumption due to an increase in income¹⁸. However, the study did not explore the price response of tobacco products on their consumption by socioeconomic status (SES) groups and cross price elasticities. A recent study, using global data from 169 countries estimated the price elasticity and affordability exclusively for cigarettes, by their income stratification [low- and middle-income country (LMIC) and high-income country (HIC)]¹. There are studies that have illustrated the impact of taxation on consumer behavior in general, and in other regions^{4,18,19}.

Currently available reviews that are specific to the SEAR are old¹⁸, and need to be updated to incorporate more recent studies. Monitoring the affordability of cigarettes over time is important, and considered 'the optimal nominal anchor for tobacco tax policy'¹⁷. Currently existing reviews that are specific to the SEAR also do not encompass the implications of change in price and consumption of tobacco products by SES^{18,20}. In addition, studies that investigate the impact of price/tax on affordability of tobacco products in SEAR countries^{2,21-23} are yet to be reviewed. Hence, the aim of this study was to comprehensively investigate the impact of tobacco prices/taxes on the consumption (primary outcome) or affordability (secondary outcome) of tobacco products in SEAR countries. We also investigated the change in affordability or consumption of tobacco products in response to price/tax change by SES; and the change in consumption of one tobacco product for a given change in price/tax on another tobacco product (cross price elasticity).

METHODS

The systematic review followed the Cochrane guidelines²⁴ and reported as per the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines²⁵. The systematic review protocol was published in the International Prospective Register of Systematic Reviews (PROSPERO 2020, CRD42020133082)²⁶.

Eligibility criteria

Studies specific to SEAR countries, illustrating the

actual impact of prices/taxes on consumption/affordability of tobacco products were eligible for inclusion. Narrative/systematic reviews and studies ‘predicting’ the impact of price change on the affordability/consumption of tobacco products were excluded from the review. We restricted eligible studies to those whose full articles were available in English. Multi-country studies, containing clear findings specific to SEAR countries were also included in the review. A detailed description of the eligibility criteria is provided in Table 1.

Search strategy

The searches were made in April 2020 on five electronic databases – Medline, Cinahl, Econlit, Embase, and Tobacconomics, using keywords for names of different tobacco products, SEAR countries, tax, and price. We did not impose any limitations on the year. The search strategy used for each database is provided in the Supplementary file Tables S1–S5. We also checked the reference lists of studies that met the eligibility criteria; made a search on the Google search engine from which the first 100 articles were screened for inclusion in the review; and searched relevant websites such as WHO, South-East Asia Tobacco Control Alliance (SEATCA), International

Agency for Research on Cancer (IARC), and other United Nations (UN) organizations.

Study selection

The studies retrieved from searches were de-duplicated using Mendeley reference management software²⁷. Each study was independently screened by two reviewers in two phases using a standardized study selection form, as per the pre-specified inclusion and exclusion criteria (Table 1 and Supplementary file Table S6). The form was piloted on 10 studies before it was used for study selection. The first phase involved title and abstract screening. Studies that were judged to be potentially eligible from their title and abstracts, or for which there was inadequate information to make an inclusion decision during the first screening phase, had their full texts screened in the second phase. Any disagreements were resolved through consensus and discussion with a third reviewer when required.

Data extraction

The included studies were imported to an open access, free web-based tool for systematic reviews, CADIMA (<https://www.cadima.info/>). An electronic data extraction form was used to extract data including

Table 1. Eligibility criteria for the studies included in the review

Criteria	Characteristics	Status
Population/ participants	Studies from WHO Southeast Asia Region (SEAR) countries namely- Bangladesh, Bhutan, Democratic People's Republic of Korea (DPRK), India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand and Timor-Leste	Included
Intervention	Tobacco price and taxation changes including specific excise, ad valorem tax, import/export duty, value added tax, mixed-tax and surcharges/cess	Included
Comparator	Irrespective of comparator or control group	NA
Outcome		
Primary	Consumption (prevalence and/or frequency) of tobacco products Affordability of tobacco products	Included
Additional	Affordability and change in consumption of tobacco products by socioeconomic status. Percentage change in consumption of one tobacco product for a given change in price or tax on other tobacco product.	Included
Study design	Cross-sectional	Included
	Case-control	Included
	Interrupted time series	Included
	Quantitative secondary data analysis	Included
	Narrative reviews	Excluded
	Econometric studies predicting the impact of price and tax changes on outcomes	Excluded
	Econometric studies not reflecting the impact of actual price and tax measures on outcomes	Excluded
	Systematic reviews	Excluded

study title, author, year of publication, population/dataset characteristics, outcome and measures of effect (Supplementary file Table S7). For those studies reporting both the impact of ‘predicted’ price/tax rise on consumption/affordability of tobacco products, and the impact of ‘actual’ price/tax changes, only the parts reporting the impact of actual price/tax changes on consumption/affordability were included in the data extraction and synthesis (Table 1). The data extraction form was an adaptation of the Cochrane Collaboration’s data extraction form for intervention reviews²⁸, and it was pre-tested on three studies before use. Data extraction from each article was conducted independently by two reviewers on CADIMA.

Study quality assessment

The Crombie’s I tool was modified and used for quality assessment of included studies²⁹. The tool was pilot tested on three studies and minor adaptations made before use. The tool comprised nine items including whether the study objectives were clearly stated, the sample size calculation was clear and representative of the population, and validated methods/models for evaluating the outcomes had been used. The detailed Crombie’s item list used in the review is given in Supplementary file Table S8. The score ranged 0–9. Studies with a score of 0–3 were marked as ‘low quality’, 4–6 as ‘moderate quality’, and 7–9 as ‘high quality’³⁰. The quality assessment of each article was also conducted independently by two reviewers. Any disagreements were resolved through discussion or consultation with a third reviewer.

Data synthesis

Data from the included studies were narratively synthesized³¹ under the following three main themes: 1) The impact of tobacco tax/price on the consumption/affordability of tobacco products; 2) The impact of tobacco tax/price on the consumption/affordability of tobacco products by SES; and 3) Cross price elasticity and consumption. Within these main themes, studies were further grouped according to the direction of the association between tax/price and affordability/consumption as follows: 1) Inverse association between tax/price and consumption/affordability (i.e. where tax/price increases were associated with reductions in tobacco product consumption, or with the products becoming less

affordable); 2) Positive or no association between tax/price and consumption/affordability of tobacco products (i.e. where tax/price increases were associated with increases/no change in consumption of tobacco products, or increases/no change in the affordability of tobacco products); and 3) Unclear association (i.e. if the impact of taxes/prices on consumption/affordability of tobacco products was not clearly drawn from the study or the authors gave contradictory interpretations in the same study). We were expecting heterogeneity across the studies in terms of their methodology, population, settings and other geographical factors. Hence, we did not plan or conduct a meta-analysis as per our protocol²⁶.

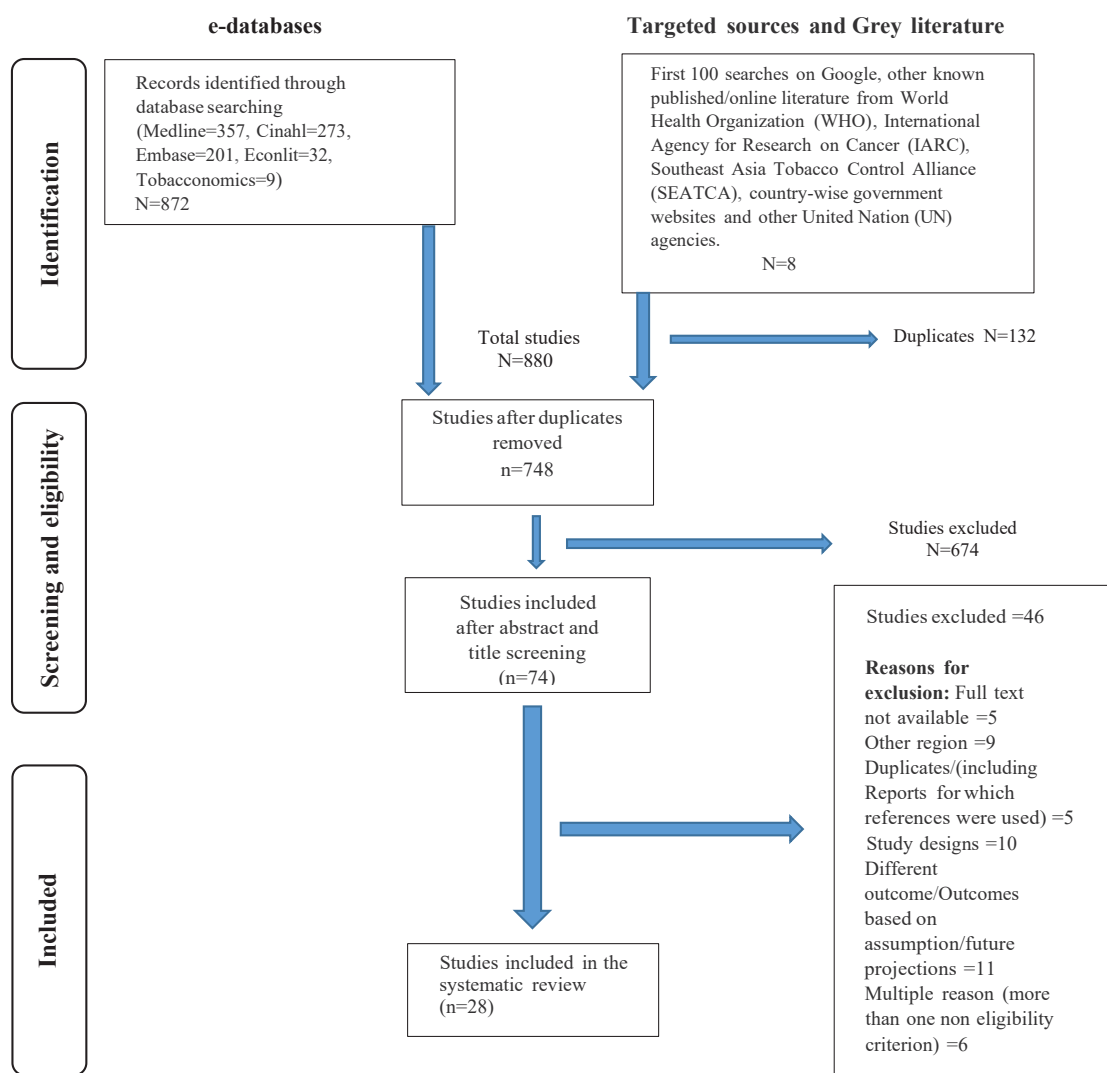
RESULTS

The literature searches resulted in 880 studies (Figure 1). Of these, 132 were duplicates and removed. After title and abstract screening of the remaining 748 articles, 74 studies were included for full-text screening. Among the 74 studies, 46 were excluded because of the following reasons: non-SEAR regions (n=9), duplicates (n=5), study design (n=10), did not report any of the outcomes of interest (n=11) and multiple reasons (i.e. not meeting more than one eligibility criterion) (n=6). Five studies were also excluded due to the unavailability of full texts, even after contacting the authors. Twenty-eight studies were included in our review. The detailed characteristics of the included studies such as the title, author information, tobacco products, intervention and outcomes are provided in the Supplementary file Tables S9–S11. None of the included studies was funded by the tobacco industry.

Overview of the studies

The highest number of included studies were from India (n=9), followed by Bangladesh (n=5), Indonesia (n=3), Thailand (n=3), Myanmar (n=2), Sri Lanka (n=2), and Nepal (n=1) (Table 2). The remaining three studies covered more than one SEAR country (Table 2). The majority of studies (n=25) involved quantitative secondary data analysis and the remaining (n=3) were primary cross-sectional studies. Most studies used national-level surveys such as the Global Adult Tobacco Survey (GATS), Tobacco Control Policy Survey (TCP), International Tobacco Control South-

Figure 1. PRISMA flow diagram of the selection phases of the studies



East Asia Survey (ITC), or government/international agency reports for consumption and pricing data, to calculate the affordability or price elasticity of tobacco products. Thirteen studies evaluated cigarettes or different variants and brands (including cheroots, hand-rolled cigarettes), two studies exclusively evaluated smokeless tobacco products and 13 studies evaluated multiple tobacco product types (e.g. bidis and cigarettes or smoked products with smokeless products). Of the 28 studies, 18 included information on our secondary outcomes. Around twenty studies reported the change in consumption of tobacco products, while six studies reported the

change in affordability of tobacco products and two studies reported both change in consumption and affordability of tobacco products (Table 2). The majority of the studies reporting inverse association between price and consumption/and affordability of tobacco products have used adjusted odds ratio or marginal coefficient as measures of association between price and outcome variables. Whereas the majority of studies reporting positive or no association between price and consumption/affordability of tobacco products had merely measured the change in frequency of the outcome measure in response to price change (Supplementary file Table S10). Additionally,

the majority of the studies with inverse association had comprehensively adjusted the socioeconomic variables or adjusted for the cross price elasticity in their analysis. In contrast, only a few studies ($n=5$) reporting positive or no association had adjusted for socioeconomic or cross price elasticity in their results (Supplementary file Table S11).

The impact of tobacco price/tax on the consumption/affordability of tobacco products

Among 20 studies reporting the outcome in terms

Table 2. Characteristics of the studies included in the review

Characteristics	<i>n</i>
Countries (SEAR)	
India	9
Bangladesh	5
Malaysia	0
Indonesia	3
Thailand	3
Timor-Leste	0
Myanmar	2
Democratic Republic of Korea	0
Nepal	1
Bhutan	0
Sri-Lanka	2
Multi-country (involving more than one SEAR region)	3
Study design	
Cross-sectional	3
Case control	0
Cohort	0
Secondary quantitative data analysis (or price elasticity)	25
Type of tobacco products used	
Cigarettes	13
Bidis	0
Smokeless tobacco (SLT)	2
More than one tobacco product (cigarettes, bidis, SLT and others)	13
Primary outcome	
Change in consumption (frequency/prevalence) of tobacco products (primary)	20
Change in affordability of tobacco products (secondary)	6
Both affordability and consumption as outcomes	2
Additional outcomes	
Socioeconomic status (SES) analysis	7
Cross price elasticity	8
Both SES and product cross price elasticity	3

of consumption, the majority, i.e. 12 studies, reported an inverse, whilst three reported positive, and two reported no association between price and consumption of tobacco products. The remaining 3 studies reported unclear interpretations on the price response of tobacco products on their consumption. Of 6 studies reporting the outcome in terms of affordability of tobacco products, 2 reported positive association, 3 reported no association, and 1 reported unclear interpretations on the association, between price and affordability of tobacco products (Table 3 and Supplementary file Table S10). The price-elasticity estimates of smokeless tobacco were reported as -0.59^{32} , -0.87^{33} and -0.9^{34} in India; and 0.64 to -0.39 in Bangladesh³⁵. The price elasticity estimates for cigarettes were reported as: 0.059 to 0.104³⁶ in Thailand; -0.38 to -0.19^{33} in India; -0.49^{37} in Bangladesh; -0.02^{38} in Indonesia; and 0.36³⁹ in Myanmar. A detailed account of the findings is given below.

Studies reporting an inverse association between price/tax and consumption/affordability of tobacco products

Consumption

Five studies conducted in India^{32-34,40,41}, two in Bangladesh^{35,37} and one each in Nepal⁴², Thailand⁴³, Sri Lanka⁴⁴, Myanmar³⁹, and Indonesia³⁸, reported an inverse association between price and consumption of tobacco products (Table 3 and Supplementary file Table S10). Of the 5 studies in India, two showed an inverse association between price and consumption exclusively for smoking tobacco (cigarettes and bidis)^{40,41}, one exclusively for smokeless tobacco³⁴, while the remaining two for both smoking and smokeless tobacco products^{32,33}. The price elasticity of smokeless tobacco was between -0.09 and -0.87 (-0.0934 , -0.5932 , and -0.8733) while that for smoking tobacco was between -0.27 and -0.92 ; -0.92^{33} and -0.27^{32} for bidis, and -0.38^{33} to -0.41^{32} for cigarettes. A study conducted in Bangladesh, using two waves of ITC survey (2009 and 2010) estimated the cigarette price elasticity to be -0.49^{37} . Another study from Bangladesh also using the ITC survey data estimated the price elasticity for smokeless tobacco to be -0.39 to -0.64^{35} . Similarly, negative price elasticity estimates for smoking tobacco products were estimated for Nepal (-0.88 for cigarettes and bidis)⁴²,

Table 3. Own price elasticity, consumption and affordability of tobacco products

Study number	Study ID ^a	First Author ^a Year	Country	Product	Authors' conclusions	Measure of outcome	Relationship between price and consumption/affordability	Quality
1	2	Nargis 2019	Bangladesh	Cigarettes and bidis	Few externalities undermined the effectiveness of tax and prices, thereby increasing cigarette consumption in Bangladesh	Consumption	Positive	High
2	3	Hussain 2017	Thailand	Cigarettes	Overall, no change in national affordability of cigarettes	Consumption and affordability	No	High
3*	4	Blecher 2004	Sri Lanka, Thailand, Bangladesh, India, Indonesia	Cigarettes	The average annual percentage change in RIP (%) of cigarettes from 1990–2001: i) Sri Lanka: Decrease, ii) Thailand: Increase, iii) Bangladesh: Decrease, iv) India: Decrease, v) Indonesia: Increase	Affordability	Unclear	High
4	5	Shang 2018	India	Cigarettes and bidis	The cigarette prices were significantly associated with lower hazards of smoking onset**. Higher bidi prices were significantly associated with a lower hazard of bidi smoking onset**.	Consumption	Inverse	High
5	7	Kostova 2015	India	Smokeless tobacco	Higher ST prices were found to reduce ST use at the intensive margin.	Consumption	Inverse	Moderate
6	8	White 2015	Thailand	Cigarettes	Although 50.1% of all smokers decreased consumption. The marginal effects of cigarette prices on consumption (price elasticity) were small and of the wrong sign for two of four models. It did not alter the intensity of continuing smokers.	Consumption	Contradictory statements within the study, hence unclear	High
7	11	John 2008	India	Cigarettes, bidis and leaf tobacco	The proportionate increases in price lead to slightly less than proportionate reductions in consumption in the case of bidis and leaf tobacco, while leading to much less proportionate reductions in consumption in the case of cigarettes.	Consumption	Inverse	High
8	14	Zheng 2018	Indonesia	Cigarettes	From 2002 to 2016, cigarette consumption steadily increased, in association with an increase in affordability.	Consumption as well as affordability	Positive	High

Continued

Table 3. Continued

Study number	Study ID ^a	First Author ^a Year	Country	Product	Authors' conclusions	Measure of outcome	Relationship between price and consumption/affordability	Quality
9	20	Jha P 2012	Thailand and India	Cigarettes	Although mentioned that large taxes are an effective instrument in reducing the number of smokers but no clear-cut interpretations could be drawn on the impact of price on consumption.	Consumption	Unclear	Moderate
10	22	Kengganpanich 2009	Thailand	Cigarettes	The cigarette consumption reduced after tax increase.	Consumption	Inverse	High
11	24	Joseph 2013	India	Cigarettes, bidis and gutka	Based on the price elasticity estimates calculated in the study, higher tobacco prices can be an effective deterrent in participation among youth.	Consumption	Inverse	High
12	26	Nargis 2014	Bangladesh	Cigarettes	Cigarette price leads to less than proportionate decrease in consumption.	Consumption	Inverse	High
13	28	Nargis 2018	Bangladesh	Cigarettes, bidis and smokeless tobacco	The affordability of bidis and cigarettes increased while SLT remained unchanged.	Affordability	Positive for bidis and cigarettes; no for SLT	High
14	29	John 2020	India	Cigarettes, bidis and SLT	The overall affordability of products has increased post GST. ***	Consumption and affordability	Unclear	High
15	36	Huq 2018	Bangladesh	Cigarettes	While the top two tiers did not see any major shift but the consumption increased in low and medium tier.	Consumption	Positive	High
16	37	Guindon 2019	India	Cigarettes and bidis	Bidis and cigarettes have become substantially affordable, despite the price increase.	Affordability	Positive	High
17	39	Fernando 2019	Sri Lanka	Any type	Increasing the price of tobacco products has no significant impact on smoking behaviors.	Consumption	Positive	Low
18	45	Shang 2017	India	Cigarettes, bidis and dual	Higher state cigarette VAT rates in India were significantly associated with lower smoking.	Consumption	Inverse	High
19	46	Nargis 2014	Bangladesh	SLT-zarda	The price of zarda appears to influence the prevalence of zarda use negatively as expected.	Consumption	Inverse	High
20	55	Arunatilake 2000	Sri Lanka	Overall tobacco	Based on the price elasticity estimates; price increases are effective in reducing tobacco consumption.	Consumption	Inverse	High

Continued

Table 3. Continued

Study number	Study ID ^a	First Author ^a Year	Country	Product	Authors' conclusions	Measure of outcome	Relationship between price and consumption/affordability	Quality
21	66	John 2010	India	Cigarettes, bidis and chewing	All products have become more affordable (based on RIP computed for all the three types).	Affordability	Positive	Moderate
22	67	Report 2014	Myanmar, Indonesia and Thailand	Cigarettes	No definite answer for Myanmar. Increased prevalence for cigarette smoking in Indonesia. While for Thailand as taxes increased, the prevalence decreased.	Consumption	Unclear	Moderate
23	69	Adioetomo 2005	Indonesia	Cigarettes	Price increase will have effect on quantities of cigarettes consumed, based on the negative price elasticity estimates.	Consumption	Inverse	High
24	70	Yurekli 2003	Nepal	Cigarettes and bidis	Negative price elasticity estimates; Increase in excise taxes would reduce consumption.	Consumption	Inverse	High
25	71	Kyaing NN 2005	Myanmar	Cigarettes, cheroots, SLT	Based on the price elasticity estimates higher prices of tobacco products will lead to reduced consumption.	Consumption	Inverse	High
26	72	Kyaing 2003	Myanmar	All tobacco products	Cigarette affordability did not change much but cheroots have become much more affordable.	Affordability	No as well positive	Moderate
27	73	Djutaharta 2005	Indonesia	Cigarettes	Overall, the trend in cigarette consumption neither increased or decreased.	Consumption	No	High
28	74	Goodchild 2020	India	Cigarettes, bidis and chewing	No significant change in affordability of bidis and cigarettes. While affordability of SLT has reduced significantly.	Affordability	No as well positive	Moderate

^a The reference for each Study ID is given in the Supplementary file Table S9. *These interpretations were given in graphs and not explicitly stated by the authors. Hence, no clear inferences could be drawn for findings specific to WHO-SEAR countries. **In study 5, onset refers to a created dummy variable and pertains to start of tobacco use in the given year (coded as 1, and 0 for non-smokers). ***The author does say that this is due to no increase in taxation within GST regime, unlike high VAT tax. Note: Although affordability is expressed as RIP (%) in most of studies, increase in RIP means tobacco products become expensive, however for easy interpretation of results 'direct' relationship between price and affordability of products means that products have become more affordable despite the price increase.

Indonesia (-0.02 for cigarettes)³⁸ and Myanmar (-0.36 for cheroots, and -0.25 for cigarettes)³⁹. One study estimated the overall price elasticity for all tobacco products to be -0.53 in Sri Lanka⁴⁴. A cross-sectional telephone survey among 504 daily smokers in Thailand reported that in response to an increase in

cigarette excise tax from 80% to 85%, 48% of the daily smokers reduced their amount of cigarettes smoking⁴³. Around 17.3% and 7.6% of smokers reduced the number of smoking days and number of cigarettes per day, respectively (Table 3 and Supplementary file Table S10)⁴³.

Affordability

We did not identify any studies reporting an inverse association between price/tax and affordability of tobacco products.

Studies reporting a positive or no association between price/tax and consumption/affordability of tobacco products

Consumption

One study each from Thailand⁴⁵, Sri Lanka⁴⁶, Indonesia⁴⁷, and Myanmar⁴⁸, reported positive or no association between price and consumption of tobacco products. In Bangladesh, two studies reported a positive^{49,50} association between price/tax of tobacco products with their consumption.

Affordability

There were three studies from India that reported no or a positive association between price and affordability of tobacco products (Table 3 and Supplementary file Table S10)^{2,23,51}. One of the studies suggested that smoked (cigarettes and bidis) products became cheaper between 2000 and 2017⁵¹, and another suggested all the tobacco products (cigarettes, bidis, and chewing tobacco) became cheaper between 1996 and 2007, despite the increase in the price of tobacco products². Additionally, one study each in Thailand⁴⁵ and Indonesia⁵² reported direct or no change in the consumption as well as in affordability of tobacco products besides the increase in their price.

Studies with unclear interpretations of the relation between price/tax and consumption/affordability of tobacco products

Consumption

A study in Thailand³⁶, using two panel datasets from ITC surveys (2005 and 2006) to investigate the response of cigarette smokers to an increase in price found that 50% of the smokers decreased their consumption, but 19.9% of smokers also increased the intensity of smoking (more than 1%), despite the price change. Hence, no clear-cut inference could be drawn based on these findings³⁶. Another multi-country study (Myanmar, Indonesia, and Thailand)⁵³ demonstrated a mixed impact of taxation (as a % of price) on cigarette consumption. While the author did not explicitly state the results for Myanmar, the findings suggested increased cigarette smoking prevalence

in Indonesia and decreased smoking prevalence in Thailand in response to increase in cigarette prices/taxes (Table 3 and Supplementary file Table S10)⁵³. Another two-country study (Thailand and India)⁵⁴, discussed the role of prices and consumption of cigarettes. The study concluded that high prices decrease cigarette consumption. Although the study enlisted the prices and prevalence of smoking for the respective countries, it did not explicitly state/discuss the impact of prices on consumption for the respective countries⁵⁴.

Affordability

The study conducted by Blecher et al.⁸ reported increased affordability of cigarettes in India, Bangladesh and Sri Lanka, and decreased affordability of cigarettes in Indonesia and Thailand from 1990 to 2001. However, individual price increase for respective countries for the change in affordability were not explicitly stated in the study⁸. Another study conducted in India²² reported that tobacco products have become more affordable (i.e. cheaper) after the enactment of the Goods and Services Tax (GST in 2017–2018) when compared to the period where Value Added Tax (VAT) was implemented between 2015–2016, due to no revisions in taxes under the GST regime unlike the VAT regime (Table 3 and Supplementary file Table S10). The authors reported that bidis had become less affordable in the states with lower VAT rates, after the first year of GST implementation, but this reduction in the affordability of bidis was not sustained in the consecutive years due to no revisions in the taxes. The authors did not explicitly state separate values for prices and affordability of products in the VAT and GST period in the analysis. Therefore, no clear-cut inference could be drawn regarding the impact of taxes on the affordability of tobacco products.

The impact of tobacco price/tax on the consumption/affordability of tobacco products by SES

Consumption

The studies conducted by Hussain et al.⁴⁵ and Nargis et al.³⁷ reported the price response of tobacco products of their consumption by education status. Hussain et al.⁴⁵ reported a higher likelihood of consumption of upper-tier price brands amongst individuals with

Table 4. Change in own price elasticity, consumption and affordability of tobacco products by SES and cross price elasticity of tobacco products (secondary outcome)

Study number	Study ID ^a	First Author ^a Year	Secondary variable reported	Authors' conclusions
Consumption				
1	3	Hussain 2017	Education (completed college or university, income quintiles)	Smokers with higher educational level and income show higher odds of consuming upper price-tier brands.
2	24	Joseph 2013	Price elasticity of products based on income	Income is positively associated with participation to tobacco use.
3	26	Nargis 2014	Conditional price elasticity based on household income	Poorer people are more price-sensitive than the rich
4	55	Arunatilake 2000	Conditional price elasticity on SES: Poorest (1) to Richest (5) Expenditure groups	With increase in price of tobacco the per capita consumption of tobacco decreased by highest amount in the middle three SES groups.
5	69	Adioetomo 2005	Based on SES (household income): Total price elasticity Conditional demand elasticity Price elasticity of smoking participation	The poorest households most likely decrease the quantity of cigarettes consumed in response to a price increase. The lower the income group, the more responsive they are to price increases.
6	70	Yurekli 2003	Price elasticity (PE) on income groups from Lowest (1) to Highest (4) group	Poorer households were more sensitive to price changes compared to richer households.
7	71	Kyaing NN 2005	Conditional price elasticity based on income quintiles	The poorest groups are the most sensitive to a price increase.
Affordability				
8	28	Nargis 2018	Association of use post price increase with SES	Cigarettes are more affordable for people from high SES compared with low and moderate SES.
9	37	Guindon 2019	Affordability (RIP%) of bidis and cigarettes based on SES	Low-SES households reported paying lower prices than high-SES households, especially in bidis compared to cigarettes.
Cross price elasticity of tobacco products and consumption				
10	2	Nargis 2019	Cross price elasticity of cigarettes with bidi and dual smokers between 2009 and 2017.	Despite a relative increase in price of cigarettes relative to bidis, it has driven the migration of bidi smokers to cigarettes.
11	5	Shang 2018	Cross price-elasticity of cigarettes and bidis prices with any smoking onset.	Bidi prices may have a greater impact on reducing smoking onset than cigarette prices.
12	7	Kostova 2015	Cross price elasticity of bidi with SLT.	The cross price elasticity estimates were imprecise and not statistically significant.
13	8	White 2015	Cross price elasticity with both and RYO.	The positive cross price elasticities suggest that both mixed use and RYO tobacco are substitute goods for cigarettes.
14	11	John 2008	Cross price elasticity for cigarettes, bidi and leaf tobacco with each other.	Any increase in the price of bidis will have greater effects in reducing consumption of cigarettes as well.
15	36	Huq 2018	Cross price elasticity of cigarettes within different price tiers.	An increase in prices significantly increases the probability of up trading and decreases the probability of down trading. An increase in income increases the probability of up trading and decreases the probability of down trading.
16	39	Fernando 2019	Cross price elasticity with alternative products (%)	More than 80% of smokers had not used any alternatives instead of tobacco products after raising the price of tobacco products.

Continued

Table 4. Continued

Study number	Study ID ^a	First Author ^a Year	Secondary variable reported	Authors' conclusions
17	45	Shang 2019	Cross price elasticity and association for cigarettes and bidis (2009–2010 and 2012–2013).	Higher cigarette VAT rates were significantly associated with lower dual use of cigarettes and bidis in GATS. The corresponding elasticity estimates show that an increase in cigarette VAT rates was associated with a decrease in dual use in the TCP data as well GATS data.
18	46	Nargis 2014	Cross price elasticity for cigarettes, bidis and zarda prevalence (in marginal effect coefficient).	Cigarette price has a positive effect on zarda use prevalence. However, there may not be any substitutability between bidi and smokeless tobacco.

^a The reference for each Study ID is given in the Supplementary file Table S9.

higher education level (Table 4 and Supplementary Table S11). Studies conducted by Nargis et al.³⁷ and Arunatilake et al.⁴⁴ used household income or expenditure to report the change or associations with consumption of tobacco products. Other studies suggested a higher price sensitivity of tobacco use among poor households or lower SES compared to the rich/higher SES (Table 4 and Supplementary file Table S11).

Affordability

A study conducted in Bangladesh with data from 2009 to 2015 reported increased affordability of cigarettes among people belonging to higher SES (marginal effect coefficient -2.09, S.E. 0.38) (Supplementary file Table S11)⁶. Another study assessing the trends in affordability of cigarettes and bidis from the year 2000 to 2018 in India, reported that low SES households pay lower prices for bidis in comparison to the high SES households². The study reported an increasing gap in self-reported prices of bidis between high and low SES households, while for cigarettes the self-reported prices for high and low SES were almost similar (Table 4 and Supplementary file Table S11)².

Cross price elasticity and consumption

Eight studies reported the cross price elasticity or change in consumption of one tobacco product due to the change in the price of another tobacco product (Table 4 and Supplementary file Table S11). Three studies reported the change in consumption of smokeless tobacco due to a change in smoked tobacco prices (cross price elasticity)^{34,35,46}. Some studies also reported changes in cigarette prices

leading to a significant shift to other tobacco product consumption^{35,36,40}; and vice-versa^{33,49}. Three studies reported both the change in consumption and cross price elasticity of tobacco products in their respective findings^{32,40,49}. A study conducted in Thailand, demonstrated that an increase in the price of manufactured cigarettes increased the likelihood of consumption of hand-rolled cigarettes (RYO) and vice-versa³⁶. Another study reported the cross-price elasticity of cigarettes to bidis (i.e. change in bidi consumption in response to cigarette prices) to be -0.091 and -0.455 for urban and rural regions, respectively (Supplementary file Table S11). However, the coefficient for cross price elasticity was small and insignificant³³. The cross price elasticity often helps in indicating a shift in consumption to substitutes/complementary products. Besides directly stating the cross price elasticity of tobacco products, few studies also linked the increase in the price of one tobacco product to the shift of tobacco consumers to other tobacco products or brands^{46,50}. We, however, do not describe the findings of product shifting/substitution in detail in this study, and limit ourselves to reporting clear findings of cross price elasticity only.

Study quality

The mean quality score for studies in our review was 7.5. Most (n=21) studies were of high quality; six studies were of moderate quality and only one study was of low quality. There were no major differences in the findings of studies (regarding the impact of tobacco prices on their consumption/affordability) based on the quality of studies. The mean score for quality of studies reporting inverse association,

direct or no association, and unclear association between price and consumption/affordability of tobacco products, were 7.9, 7, and 7.3, respectively. The detailed scoring for each study is provided in Supplementary file Table S12.

DISCUSSION

This review found that the majority of the studies examining the impact of price/tax on tobacco product consumption reported an inverse association. This is consistent with what is already known of this relationship, i.e. the true association of cigarette prices/taxes are statistically significant and negative towards cigarette consumption, making tax/price measures effective in controlling cigarette consumption⁵⁵. Nevertheless, a number of studies also reported positive associations or no association, between price/tax and consumption of tobacco products. The differences in findings might be attributed to the fact that studies showing an inverse association tend to be those that comprehensively adjust for SES variables/cross price elasticity of tobacco products in their analysis, whilst those reporting positive or no association tend not to. The range of price elasticity estimates reported by the studies included in the current review (smokeless tobacco -0.09 to -0.90 and smoking tobacco -0.02 to -0.88) was wide, but includes those reported in the 2003 review (the short-term and long-term price elasticity as -0.50 and -0.70, respectively) focusing on the SEAR¹⁸. For affordability, all studies identified reported either a positive/no association or unclear findings.

Tobacco users from lower SES groups were found to be more price-sensitive in comparison to those belonging to more affluent groups. A few studies reported the increase in consumption of one tobacco product in response to the increase in the price of another tobacco product (cross price elasticity). Other studies further linked the cross price elasticity to product or brand shifting as well^{46,50}. Therefore, as per our stated secondary outcome in the protocol, we limited ourselves to reporting clear findings of cross price elasticity only.

The existing literature suggests that for tobacco products, the price is an important determinant of consumption/affordability⁵⁶⁻⁵⁹. However, while price plays a role in regulating the consumption/

affordability of tobacco products, the per capita income growth of the country can influence this relationship^{17,59}. The reported positive associations or lack of association between the price and consumption of tobacco products by some studies conducted in Bangladesh^{6,37,49}, Thailand⁴⁵, India^{2,23} and Indonesia⁴⁷ could be due to higher economic growth (and therefore, higher income growth) relative to the increase in tobacco prices in these countries. Further, product-substitution involving switching to cheaper alternatives, and heterogeneity among the tobacco prices along with their complex taxation tiers are also potential reasons for no or positive association between tobacco product prices and consumption¹². The heterogeneity in prices of tobacco products may incentivize tobacco users to migrate to cheaper alternatives, thereby diluting the impact of an increase in tobacco prices on consumption^{60,61}.

The findings of this review indicate that lower SES groups are more price responsive than the higher SES groups, suggesting that tobacco price/tax measures could contribute to addressing tobacco-related health inequalities within and across countries. This is particularly important for tobacco epidemic in the LMICs, where the majority of smokers live and the health and economic burden of tobacco use is greatest, including those in the SEAR.

Implications for policy, practice and research

Our review supports the use of tobacco tax and price measures as effective tools to address the tobacco epidemic, as well as the socioeconomic discrepancies in tobacco consumption and tobacco-related health and economic burden⁵⁶⁻⁵⁸ in the SEAR. However, our findings also suggest that there is a need to increase the tobacco taxes and prices to levels that are sufficient to result in an increase in the real price (and therefore reduce affordability) of tobacco products, in order to reduce consumption. In addition, specific taxes and levying taxes uniformly across all tobacco products, without any exceptions or tiers would help to address shifting to cheaper alternatives/product substitution and tax pass through, and therefore strengthen the effects of tobacco-related fiscal policies⁶². The administrative costs involved in levying and collecting taxes on tobacco are small when compared with the health benefits. Revenue from taxes can be used by governments to fund vital health and other services

for populations in the region. There are diverse micro as well as macro level socioeconomic, geographical, and cultural challenges associated with tobacco epidemic across various countries. However, by focusing on a regional level, our review contributes to a better understanding of what policies countries might need to work together on, and advocate for, collectively to address the cross-country and cross-cultural challenges. Our policy recommendations could also be replicated in other similar regions⁶³.

We recommend future SEAR studies on this topic to utilize robust study designs and data analysis approaches that allow for causal inferences, for both affordability and consumption. Studies investigating the relationship between tobacco prices/taxes and their real as well as nominal price is particularly needed. In the present review, we did not identify any study meeting our eligibility criteria for a few of the SEAR countries such as the Democratic Republic of Korea, Timor-Leste, Maldives, and Bhutan. Therefore, more country specific research should be encouraged in order to help to understand both the country- and regional-level impact of tax and price tobacco control measures. The deficiency of comprehensive approaches to measure the impact of tobacco control measures in general as well as across SES is also acknowledged in previous reviews⁶⁴.

Strengths and limitations

As far as we are aware, this is the first systematic review after the advent of MPOWER strategies, to examine the price/tax response of all the tobacco products (smoking and smokeless tobacco) on their consumption/affordability in countries of SEAR. We have drawn our interpretations based on the studies conducted in this region, without any limitation on the year. We have also disaggregated the impact of prices/taxes on consumption/affordability by SES indicators. The study has certain limitations. Due to the limited number of studies and wide heterogeneity across the studies in terms of their intervention as well as reporting of outcomes, we were unable to conduct a meta-analysis. Although we have mentioned the given price/tax estimates for each study in the Supplementary file, we could not present the impact of taxes on real or nominal price of tobacco products. There was no major difference in the change in affordability/price elasticity estimates within studies

for smoking and smokeless tobacco. Hence, we did not present estimates separately for smokeless and smoking tobacco products. However, the tables in the Results section do present the estimates separately for each product (cigarettes, bidis, smokeless or other) from the respective studies. The majority of studies in the review were retrospective in design, drawing estimates from previous datasets such as the GATS, TCP, ITC, etc. Although such studies encompassed large populations, the outcome estimates derived from them can vary in survey designs, sampling methods, populations as well as country specific differences.

CONCLUSIONS

The majority of included studies examining the impact of price/tax on tobacco product consumption report an inverse association, thereby supporting the use of tobacco tax and price measures as effective tools to address the tobacco epidemic. Our findings, however, also emphasize the importance of increasing tobacco product taxes and prices sufficiently to outweigh the effects of income growth, in order for the measures to be effective in reducing the affordability and consumption of tobacco products. The availability of cheaper alternatives (often due to tiered and complex taxation systems) can also undermine the effect of fiscal policies in tobacco control. These should be considered when designing future tobacco tax policies in the region.

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CONFLICTS OF INTEREST

The authors have each completed and submitted an ICMJE form for disclosure of potential conflicts of interest. The authors declare that they have no competing interests, financial or otherwise, related to the current work. All the authors report that since the initial planning of the work and in the past 36 months this research was completed as part of the Tobacco Control Capacity program and it was supported by UKRI Global Challenges Research Fund (MR/P027946/2).

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ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval and informed consent were not required for this review.

DATA AVAILABILITY

The data supporting this research can be found in the Supplementary file.

AUTHORS' CONTRIBUTIONS

GPN, MA, RH and NDM were involved in the concept and design of the study. NS, SL and AC contributed to literature searches. LB and MA secured funding for the study. NS and SMA contributed to data extraction. AC, SMA and GPN contributed to the critical appraisal of studies. GPN and NS contributed to data synthesis. GPN, NS and AC prepared the first draft of the manuscript. GPN, MA, RH, SMA, NDM, RMJ and LB reviewed the manuscript critically for intellectual content. All authors approved the final version of the manuscript submitted.

PROVENANCE AND PEER REVIEW

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